the student and of arousing his interest in it. Furthermore, it is worth one's time to learn the real significance of the morphology of the flower and to understand that it has a purpose other than to furnish means for the identification of the plant.

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COLUMBIA UNIVERSITY.

OF INTEREST TO TEACHERS

QUANTITATIVE WORK IN HIGH SCHOOL SCIENCE COURSES

BY JULIUS SACHS

From the general standpoint of the object of secondary education, and not from the point of view of a science expert, I offer you a few comments on the influence of quantitative work in our high school science courses. It is claimed that no science is worth teaching, especially no physics, that does not make for quantitative accuracy; the college officers, however, who imbue the future teachers with this view, know very little of the hesitancy and helplessness of our high-school students; they do not know, as teachers of long experience know, that the steps of the students must be carefully directed in their experimentation, and that there is much more than unaided performance in the observations they record. It is safe to say that even if the students grasp the topics handled in this mathematico-physical work, they certainly fail of seeing the larger relations of the individual experiment to the world of physical phenomena. I am inclined to reverse the usual estimate that teachers place on the relative importance of their work in the high school; to me the most valuable and most important part of the work is that effected with pupils who cannot or will not advance to the college stage; for them surely, and I should like to add for *all* high-school students, it is important that they should be led to comprehend the physical, chemical, and biological elements that enter into the various industrial, agricultural, and mechanical problems. If then you wish to add a special fundamental training along the line of quantitative work, let that constitute an advanced course for the few. The fact that in subjects appealing especially to boys and girls the initial interest wanes and that there is a diminishing choice of scientific subjects by our students proves not that pupils shirk serious work, but that much of our present science teaching is misdirected. Whatever the degree of specialization that may be desirable in a college instructor of science, the high school requires teachers of breadth of view; you cannot satisfy the pupil's desire for a broad outlook into the interrelations of phenomena, unless you yourself possess it. Too many of our teachers believe themselves discredited in the eyes of their associates, if they profess interest in three or four related fields of scientific inquiry; we cannot too soon revert to the type of scientific teacher that the Huxley school stood for — the man who sees the application of natural laws in several fields of organic and inorganic science. This need not involve superficiality; a teacher may still be preëminently interested in one line of inquiry, and yet recognize the duty of arousing his pupils to the relationship that pervades the world of phenomena.

TEACHERS COLLEGE.

QUANTITATIVE WORK IN HIGH SCHOOL BOTANY

BY JOSEPH Y. BERGEN

In reply to your request for an opinion in regard to quantitative work in high school botany I am glad to say a few words.

The question is really a general one — the high school teacher of almost every science subject, from chemistry to botany, has had to ask himself whether any quantitative work should be done, and if it is undertaken what proportion of the total laboratory time it should occupy and what degree of accuracy is to be required.

To me it seems that both extremes are wrong. Some of the worst-fitted candidates for the Harvard University entrance examination in physics used to come from schools on the one hand in which hardly any measurements of objects which could enter the jaws of a micrometer caliper were made without its agency, or from schools on the other hand in which the teacher's demonstrations of physical principles were only less entertaining than the monthly public declamations or the recitals of the banjo club.

It would seem to be folly to bar out from the laboratory work in botany such studies as those on the blanching effect of cutting off light from green portions of the plant body, because it is not easy to express the effect in convenient units. So, too, it is well worth while to have every student produce positive and negative heliotropic movements in convenient portions of the plant body, and yet it would be an unprofitable labor to determine exactly what per cent. of the total sunlight is required to initiate such movements. But even the beginner in botany (of high school age) cannot get out of his subject nearly all that it can give him unless he has made some careful quantitative studies, not all of them necessarily physiological. For example, a few of the topics which readily lend themselves to quantitative treatment are: the relation of temperature to germination, to asexual reproduction (as in bacteria and yeasts), the percentage of water in the plant body, the effect of lowered temperature on root absorption, the approximate pressure of the root tip, the effectiveness of corky epidermis in preventing evaporation, the relative transpiration rates at various temperatures, critical temperatures and illuminations to produce nastic movements of foliage leaves and floral leaves, the minimum illumination for typical shade plants, and the number of competitors on a unit area of weedy soil. If the teacher has not had considerable practice in making quantitative studies of the character of those here mentioned, he may find it highly profitable to complete a goodly number of them and then endeavor to make a statement of the comparative accuracy and vitality of his knowledge of each topic before and after subjecting it to quantitative investigation.

If botany is to stand as an important subject in high school courses it must claim a place there not only because it fosters a love of nature and cultivates the esthetic sense — and these it should do — but also because it affords training in careful observing and scientific thinking. Will the botany teacher who objects to quantitative laboratory work be good enough to suggest to those of us who do believe in it any substitute for such work which can be guaranteed to go as far in developing rigorous habits of thought?

Cambridge, Massachusetts.

Starch grains are made the subject of a recent paper by Professor Henry Kraemer, of Philadelphia. Among the statements of interest to high school pupils are the following: The starch grain consists of two nearly related substances, the one a colloid, which takes up aniline stains, and the other a crystalloid, which becomes blue with iodine. The starch grain is made up of concentric layers, one series of which contains a large proportion of crystalloids, while the other alternate layers are composed mostly of colloids. While heating the starch grains in water rapidly changes the structure of the grain, it is only upon the addition of chemicals or ferments that denaturization is brought about.

Dr. John W. Harshberger has recently found a slime mould which had left its saprophytic habit, assuming a grass-killing one. The slime mould, *Physarum cinereum* Pers., formed over night "patches of blackened grass," and in "a few days these black patches, if disturbed with the foot or a stick, gave off little clouds of dark brown spores. The original patches were small and few in number, from 6 to 12 inches in diameter and of irregular shape. The rains and damp weather of early August, 1905, aggravated the injury to the lawn, for the patches spread over much larger areas and covered portions of lawn 25 feet in diameter, of irregular outline, with smaller patches scattered in the circumscribed space." The disease affected only the leaves, for the above-mentioned patches afterward regained their fresh, green color.

The May *Bulletin* of the Torrey Botanical Club, contains an article by Harry P. Brown on algal periodicity in certain ponds and streams in Indiana which were studied throughout the year. Among the conclusions reached the following are of general interest:

1. An alga growing under steady normal conditions continues, in the region studied, to grow in a healthy vegetative state throughout the year.

2. A sudden change in external conditions checks the vegetative growth of an alga and tends to cause it to enter a resting stage or to form fruit sexually.

3. *Spirogyra varians* is the most widely distributed alga found in this region. It grows under varied conditions. It conjugates at all seasons of the year, depending on hard external conditions, *e. g.*, the drying up of the pond.

The Bureau of Plant Industry has recently given to *Science* authoritative statements regarding the nature of its seed and plant distribution. Among the beneficial activities thus described are the introduction of rapidly growing Arabian alfalfa, which at Mecca, California, last year yielded twelve cuttings instead of eight; the distribution of two new timothies, one of which ripens with red clover, the other being a large yielder; the successful introduction of the date in California and Arizona; the distribution of improved melon, cotton, and tobacco seeds; the introduction of thousands of Japanese rush and sedge plants for the matting industry; * and the department is at present importing hard bamboos from China, drought-resistant forms from India, and giant forms from Porto Rico.

An article on "Plant Pathology in its Relation to Other Sciences," by Dr. Ernest Shaw Reynolds in *Science* for June 19, contains the following: "We must know the normal functions of the plant attacked, and be able to realize in what way they have been deranged. Thus, if a parasite is the cause of the disease, it may bring about the death of the host-plant in one or more of the following ways: It may strangle the plant by clogging the water-conducting vessels, as in the bacterial "wilt" of melons, already referred to. Again, it may give out a poison which kills the pro-

* Editor's Note. — The New York *Tribune* for September 16 announces that in Saskatchewan "hundreds of square miles of reeds available for matting" have been discovered; the credit is apparently due to the United States government.

toplasm of the cells affected, as De Barry describes for one of the *Sclerotinia* diseases. The third method is by absorbing the food, water, or the protoplasm itself, from the cells of the host. This seems, at the present time, to be the most common mode of attack, especially in those diseases, like leafspots, which remain localized in some organ."

Dr. L. B. Walton, of Kenyon College, has made a study of zygospores of *Spirogyra quadrata* (Hass.) Petit to obtain data bearing — in part — upon the causes tending to produce variability. Over 400 zygospores were studied, including those formed by scalariform and by lateral conjugation. "In the first instance (scalariform conjugation) we deal with the results of conjugation between remotely related cells belonging to different filaments. In the second instance (lateral conjugation) we deal with the results of conjugation between sister or adjacent cells of the same filament, a condition closely related to the phenomena of parthenogenesis in other organisms. If the conjugation of germ cells from remotely related individuals tends to variability as Weismann and others would have us believe, conversely the union of closely related cells should afford a decreased variability, the minimum appearing in parthenogenetic forms.

"The results show a condition directly contrary to this, the zygospores of lateral conjugation being approximately 21 per cent. more variable in length and 21 per cent. more variable in diameter than those produced by scalariform conjugation. Consequently direct evidence is afforded in support of the theory of Hatschek (1887) that sex exists for the purpose of limiting and not for the purpose of increasing variability."

Science for May 22, 1908, describes the concerted action of the "owners of timber in different parts of the country in organizing associations to protect their holdings from fire. In the Pacific northwest, the Washington Forest Fire Association has just elected officers at Seattle and begun work for the year with 3,000,000 acres under its care. The plans include a system of patrol by rangers resembling the work done by the United

States Forest Service in guarding against and extinguishing fires. Organizations of similar kind and for a like purpose are at work in Oregon and Idaho. In the latter State, a portion of the expense is borne by taxation and paid from the State Treasury. A western railroad company which holds large tracts of timber has taken steps to guard its property from fire, and during the short time that its plans have been in operation, it has met with most encouraging success. Similar work is being done on the other side of the continent. Forest owners in Maine have gone to work in the same systematic way to control the forests' great enemy, fire. Like organizations are found in other parts of the country, showing how fully it is now realized that protection against fire is of the greatest importance. It is safe to say that fires in this country have destroyed more timber than lumbermen have cut. When timber was abundant, the waste passed almost unnoticed, but now that a scarcity is at hand and an actual wood famine threatens in the near future, the owners of forest lands are waking up and taking action to save what is left." The extensive fires in British Columbia and northern United States this summer emphasize the importance of such measures for the preservation of our forests.

The *Plant World* for May contains an article on "Leather from Cacti: Something New," by Frederick C. Wright. The author says that, "One day, over a year ago, the writer, while handling a piece of bisnaga (*Echinocactus wislizeni*) noticed, after the water it contained was pressed from the fiber," that it became very pliable and strong, like leather, but brittle and chalk-like when dry. Then, "not being a scientist," he began a series of crude experiments to obtain both strength and pliability, which he describes as follows: "I boiled the fiber with mesquite bark and burnt rags to tan and color it. I secured the color, but the fiber did not tan. I soaked it in oil; I used aluminum palmitate, tannic acid, gum arabic, caoutchouc, and I used glue, but none of these gave results. But, late one night soon after, I went to bed and slept the sleep of contentment, with a piece of perfect leather made from cactus fiber in my hand. I used water and glycerine, about

25 per cent. of the latter." On account of the large proportion of water contained in a bisnaga or sahuaro, if the fiber is cut one half inch thick it reduces to about one sixteenth of an inch in thickness. "If a circumferential cut is made (as one would peel an apple) from 20 to 40 feet in length of fiber may be obtained from cacti of the larger growths." "Immediately after cutting the fiber is placed direct in the tanning bath. The tanning process requires from two to three hours, according to the thickness of the fiber," but the drying process is more tedious. As much water as possible is first pressed from the sheet, after which it is hung up to dry, or dried by artificial heat. When dry the leather is white or tan, and may be stained any color desired. "The entire trunk of this giant, which reaches a height of 40 to 75 feet and a maximum diameter of two feet, may be utilized in the manner described, and, as the sahuaro covers an area of 120,000 square miles in Arizona and Sonora, no lack of raw material will be encountered in the application of this method of preparation."

Dr. N. L. Britton of the New York Botanical Garden describes in *Science* for March 24 the cotton found growing "in the extreme southern part of Jamaica in coastal thickets both in sand and on nearly level limestone rock where there is scarcely any soil." It was noticed over an area about a mile long and several hundred feet wide. Dr. Britton further says, "there is a total absence of weeds of cultivation, the cotton being associated with characteristic plants of the coastal lowlands. The flowers are small, the petals white with a crimson spot at the base, fading through the day to pink; the pods are small, nearly globular, the foliage pubescent or very nearly glabrous.

"There are no white residents at the place; the negroes say that the cotton was brought there in slavery times and planted, but the soil is such that no cultivation would be practicable and the remarkable absence of weeds indicates that no cultivation was attempted there; the negroes say that it was formerly collected and shipped. The occurrence of the plant at this place, associated only with native species, has given us a strong impression that it is indigenous though it may not be; at any rate it is a race of cotton that has probably been quite unchanged from its pristine condition.

"It at once occurred to us that this race might prove a very valuable one for breeding purposes, inasmuch as it furnishes a new point of departure."

Dr. O. F. Cook's comment in the same number of *Science* is partly given below.

"Professor Britton's account of the conditions under which this primitive type of cotton grows would seem to establish beyond doubt that it is really a wild plant. The very small bolls and sparse lint would seem to preclude the idea that this cotton was introduced into the island for civilized agriculture. If not truly indigenous it must have been brought in aboriginal times, or by accident.

"The existence of wild cotton in Jamaica has been claimed by Macfayden and others, but the evidence has not been convincing. Macfayden described two species of cotton (*Gossypium jamaicense* and *G. oligospermum*) as native to Jamaica, but both are said to have yellow flowers and have been reckoned as forms of Sea Island cotton (*Gossypium barbadense*). White flowers are not known in any cottons of the Sea Island series. In the characters of the seeds and bolls Professor Britton's cotton closely resembles a type which grows wild on the Florida Keys."

NEWS ITEMS

Dr. J. M. Reade has been promoted from instructor to professor of botany at the University of Georgia.

Dr. Friedrich Hildebrand, professor of botany at Freiburg, recently celebrated the fiftieth anniversary of his doctorate.

Mr. W. W. Eggleston is making studies and collections of *Crataegus* in Virginia and North Carolina.

Professor G. W. Wilson, of Upper Iowa University, held a research scholarship at the New York Botanical Garden during the past summer.

Professor F. S. Earle, recently director of the Estación Agro-